The two largest influences on the costs of canal prism rehabilitation are the quantity and costs of additional ROW and the canal capacity, i.e. Preferred Alternative.

4.7.5 Rehabilitation Schedule

The majority of rehabilitation for the canal prism and related in-line structures, unfortunately, must be performed during the off-season. This will involve cold-weather construction and innovative techniques. Of course, mobilization, staging and stockpiling of materials can occur prior to winter shutdown of the canal. Only limited segments or reaches can be accomplished per construction season (irrigation off-season) to ensure uninterrupted water diversion and conveyance the following season. However, multiple reaches, whether the same or different contracts, can be performed concurrently.

It would be prudent to rehabilitate those reaches with the greatest capacity restrictions so that canal capacity could be increased incrementally each successive season. However, conventional canal rehabilitation is typically performed in an upstream to downstream fashion so that construction access is extended with each completed reach. We anticipate that complete canal prism rehabilitation may require 4 to 6 seasons.

4.8 SUMMARY

4.8.1 Overview

The majority of the structures comprising the St. Mary Diversion Facilities are in poor to very poor condition and are approximately 90 years, well beyond their design life. The continued degradation has resulted in a current diversion of 670 cfs, well below its original capacity of 850 cfs. In addition, maintenance costs, just to maintain minimal service, are escalating beyond the ability of the prime beneficiaries to pay them. Water shortages in the Milk River Basin have been largely attributed to the gradual deterioration of the St. Mary River Diversion Facilities. This has been echoed in many BOR and DNRC reports, and a representation of quotes is presented below.

- "The current system of canals and storage reservoirs supply irrigators with only one-third to one-half of the water needed for full crop production in a normal year."

- "The deteriorating St. Mary Canal system and decreasing storage in Milk River reservoirs due to sedimentation are major causes of water shortage in the Milk River Basin."
- "The key component of the project is the St. Mary Canal. The 29-mile long canal has outlived its design life, having been completed in 1915. The St. Mary River Siphon in the canal and five large drop structures are in imminent danger of failure. Capacity has diminished from the design capacity of 850 cfs to about 650 cfs today."
- "Based on current trends, catastrophic failure of the St. Mary Canal is likely to occur between now and 2050."
- "The 85-year old St. Mary Canal (now 90 years) is badly in need of rehabilitation; most of the structures have exceeded their design life and thus are in need of major repairs or replacement. Canal capacity has dropped from the original 850 cfs in 1925 to about 650 cfs today. Landslides along the canal route and the dilapidated structures make the canal unreliable as a water source."

In our opinion, the St. Mary River Siphon and hydraulic drops represent the greatest potential for catastrophic failure due to their present condition and estimated damage resulting from failure. Catastrophic failure of either of these two components would result in severe and irreversible environmental damage to the St. Mary River and the North Fork of the Milk River, respectively. Repairs would most likely take two years for significant failure of one of the two siphon locations and at least one year for a failed drop. This would create an economic disaster for north central Montana directly and indirectly for the remainder of the State.

Catastrophic failure of the canal prism most likely could be repaired in the same season depending on its location. Likewise, the resulting environmental damage would be contained and less severe.

Most of the remaining components of the diversion facilities do not pose a high risk of catastrophic failure, but their overall rehabilitation is warranted to increase diversion capacity, decrease water shortages, improve operational flexibility and efficiency, improve safety, reduce maintenance costs and protect threatened/endangered species.

4.8.2 Rehabilitation Alternatives

The single largest design-related decision impacting overall rehabilitation of the St. Mary Facilities is the required and/or desired canal capacity (Preferred Alternative). The BOR has prepared cost estimates based on four flow regimes: 500, 670, 850 and 1000 cfs. Since the demand for water and the opportunity to utilize more diverted water has increased, it is impractical to consider a rehabilitated system with less than the original capacity (850 cfs).

From an engineering perspective, any reasonable capacity could be designed and constructed. From our review of previous water supply studies, justification for diversion capacity in excess of 850 cfs has been established. In our opinion, the primary factors limiting system capacity are: 1) the St. Mary River hydrology, 2) appointment requirements mandated by the 1909 Boundary Waters Treaty and the 1921 IJC Order, and 3) the potential requirements of the unsettled Blackfeet Nation Water Rights Compact.

With respect to individual structures comprising the Diversion Facilities, it is our professional opinion that there are additional alternatives beyond those mentioned by the BOR which should be considered. These alternatives may represent an initial construction savings and/or a cost savings associated with O&M activities. These alternatives, mentioned in previous discussions, include the following:

Table 4.8.1 Alternatives Proposed for Future Consideration

Hydraulic Structure	Proposed Alternatives
Diversion Dam	– Overshot style gate – greater ability to pass floating debris and ice floes – Pneumatic Crest Gate – better performance in ice-affected flow regimes – SCADA
Canal Headgates	– Fish screen alternatives with openings larger than 0.07 to 0.09 inches – SCADA
Checks and Wasteway Gates	– Overshot style gates – SCADA
St. Mary River and Halls Coulee Siphons	– Single pipe siphon – Buried cast-in-place concrete

Hydraulic Structure	Proposed Alternatives
Hydraulic Drops	– Hydropower considerations – Combining multiple drops – Open chute vs. pipe
Canal Prism	– Additional freeboard for inflows – Two-bank canal – Armoring – Realignment and reconstruction

4.8.3 Estimated Rehabilitation Costs

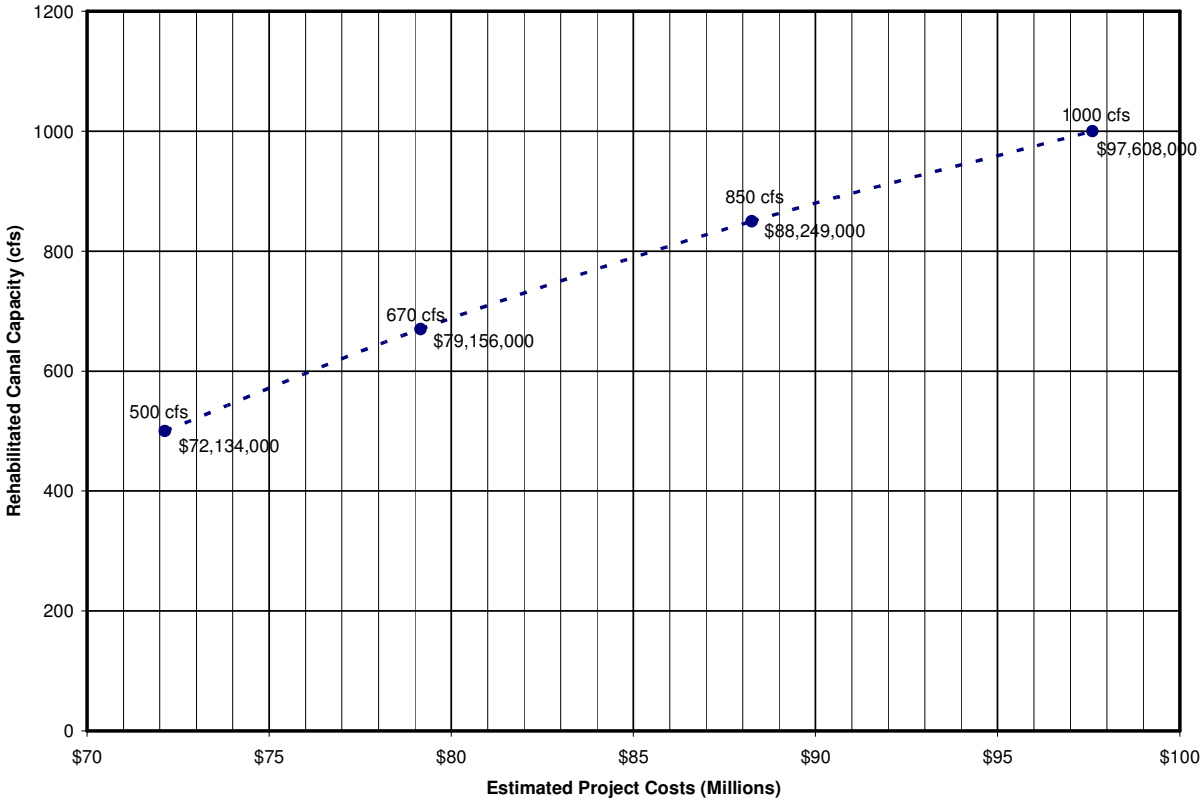
In 2003, the BOR estimated rehabilitation costs of $88,249,000 and $97,608,000 for diversion and conveyance capacities of 850 and 1000 cfs. Values for 500 cfs and 670 cfs were also prepared in order to develop a cost-capacity curve (Figure 4.8). The following represents our comments regarding our review of their studies and project cost estimates.

- Prices were developed in March 2003 (2002 for the diversion dam and headgates) and basically were out-dated when the reports were published. We have projected their estimates into the future assuming a 2007 start date. Further assuming a modest inflation index of 3%, this represents an increase of 1.1255 for 4 years. For the diversion dam and headgates, we used a factor of 1.1593 since the cost estimates were prepared in September 2002.
- Discrepancies were noted in the Engineering Appendix (BOR, 2003) between the estimating worksheets, overall summary table and summary tables prepared for discussion of individual components. In all cases, we used the higher value for budgetary purposes.
- The cost estimates for the diversion dam and headgates used 5% for mobilization, 15% for unlisted items and 25% for contingencies. No consideration was given for "non-contract costs". The cost estimating worksheets reviewed for the remainder of components and structures used 8% for mobilization, 10% for unlisted items, 25% for contingencies and 37% for non-contract items. To be consistent, we have adjusted the estimates for the diversion dam and headgates to include non-contract costs (37%).
- The BOR has indicated that the Tribal fees (5%) were not included and are not considered part of the non-contract costs. The BOR defines non-contract costs as planning, investigations, designs and specifications, contract administration, water rights,

environmental permits and rights of way. For budgetary purposes, we have increased the BOR's cost estimates by 5% to include Tribal fees.

- The BOR recommends that individual components be designed to incorporate future automation, instrumentation and remote-control capabilities. The cost estimates, however, do not include such SCADA devices. We believe it would be prudent to include such costs and incorporate this equipment into the overall project rehabilitation. We have added additional costs to the diversion dam, headgates, checks and wasteways to reflect this recommendation.
- The BOR's discussions and cost estimates for prism rehabilitation consists of "reshaping and partial lining" in accordance with Design Standard No. 3. In our December 2004 meeting, BOR personnel indicated a preference for a two-bank prism. In addition, canal reconstruction will likely be required to avoid active landslides, reduce seepage, improve efficiency, and reduce canal sinuosity. It is our preliminary opinion that the BOR cost estimate for Canal Prism Reshaping and Lining does not account for a two-bank canal prism or, partial reconstructions and realignments. We have increased their estimate by 20%. Typical construction costs for recent projects involving canal prism rehabilitation of similar nature and scope in Canada have averaged approximately $1,600,000 per mile. This difference reflects the difference between "appraisal level" cost estimating and actual construction bids.
- We are in general agreement with the BOR's original cost estimates. They represent a substantial initial effort given the preliminary nature of the overall project. At this stage, appraisal level estimates, the BOR's approach is to incorporate unknowns as design and construction contingencies. More accurate construction cost estimates would be developed as the study and design phases progress.
- It is our opinion that there are other alternatives which should be considered further in subsequent studies and that may represent cost-saving opportunities.

Figure 4.8 Rehabilitated Canal Capacity vs. Estimated Costs



Note: Estimated costs are BOR's original 2003 values.

The following table summarizes the BOR's cost estimates for only the 850 and 1000 cfs capacities along with the modified values adjusted per the discussions above.

Table 4.8.2 Estimated Overall Project Costs to Rehabilitate St. Mary Diversion Facilities (850 cfs and 1000 cfs)

Facility Component	BOR Cost Estimates - 2003		Projected Costs – 2007[1]	
	Q=850 CFS	Q=1000 CFS	Q=850 CFS	Q=1000 CFS
Diversion Dam, Fish Ladder, Headworks and Fish Screen	$9,500,000	$10,000,000	$15,947,400	$16,781,200
Canal Prism Reshaping and Lining	$33,000,000	$34,495,000	$47,000,000	$49,000,000
Landslide Stabilization	$21,000,000	$21,000,000	$24,900,000	$24,900,000
Drain Turnouts	$750,000	$790,000	$886,500	$934,000
Kennedy Creek Siphon	$950,000	$1,250,000	$1,122,700	$1,477,200
Kennedy Creek Wasteway	$560,000	$560,000	$688,000	$688,000
Kennedy Creek Check	$1,040,000	$1,160,000	$1,255,300	$1,397,100
Powell Creek Culvert	$470,000	$480,000	$555,500	$567,500
St. Mary River Siphon - Concrete	$8,500,000	$11,500,000	$10,045,200	$13,590,500
St. Mary River Bridge	$1,500,000	$1,500,000	N/A	N/A
Spider Lake Check	$1,140,000	$1,220,000	$1,407,000	$1,501,000
Cow Creek Culvert	$560,000	$560,000	$662,000	$662,000
Halls Coulee Wasteway	$1,400,000	$1,400,000	$1,714,000	$1,714,000
Halls Coulee Siphon - Concrete	$4,100,000	$4,200,000	$4,845,300	$4,963,500
Culvert -Sta. 978+61	$210,000	$210,000	$248,500	$248,500
Culvert -Sta. 1051+71	$180,000	$190,000	$213,000	$225,000
Culvert -Sta. 1093+94	$210,000	$210,000	$248,500	$248,500
Culvert -Sta. 1132+35	$210,000	$210,000	$248,500	$248,500
Culvert -Sta. 1195+65	$190,000	$200,000	$225,000	$237,000
Drop 1 - Pipe Drop Alt.	$810,000	$840,000	$957,100	$992,700
Drop 2 - Pipe Drop Alt.	$890,000	$900,000	$1,051,800	$1,063,600
Drop 3 - Pipe Drop Alt.	$790,000	$810,000	$933,600	$957,200
Drop 4 - Pipe Drop Alt.	$1,050,000	$1,100,000	$1,240,900	$1,300,000
Drop 5 - Pipe Drop Alt.	$890,000	$930,000	$1,051,800	$1,099,100
O&M Roads	$45,000	$45,000	$53,500	$53,500
Tree Removal	$320,000	$320,000	$378,500	$378,500
Land Acquisition	$54,000	$108,000	$64,000	$128,000
Fencing	$1,420,000	$1,420,000	$1,679,000	$1,679,000
TOTAL	**$91,739,000**	**$97,608,000**	**$119,622,600**	**$127,035,100**

[1] Cost estimates adjusted and projected per previous discussions.